Light Vision

Objectives
Students will (1) explain why color patterns easily seen in the air are difficult to see underwater, (2) make inferences about the problems of predators searching for camouflaged prey.

Curricular Areas
Science and Language Arts

California Content Standards
GRADES 3-8

Science

3rd Physical Science 2 b, c, d; Life 3 a, b, c; Investigations 6 a, c, d
4th Life 3 b; Investigations 6 a, c, d
6th Life Science 5 c, d, e; Investigations 7 d, e
7th Evolution 3 a; Living Systems 5 g; Physical Science 6 b, c, e, f; Investigations 7 a, c, e

Language Arts

3rd Speaking 1.0, 2.0
4th Speaking 1.0, 2.0
5th Speaking 1.0, 2.0
6th Speaking 1.0, 2.0
7th Speaking 1.0, 2.0
8th Speaking 1.0, 2.0

Method
Students will create and observe a simulated underwater environment and role-play a predator-prey relationship.

Materials
- Time to complete: (1) 50-minute class period
- blue cellophane (found at school art supply store)
- stapler
- clear tape
- string
- underwater photographs cut from magazines that show bright colors and others that are of wide views that are predominantly blue (SCUBA magazines or *National Geographic* are good sources)
- red construction paper, 4" x 8"
- other contruction paper or poster stock 4" x 11"
- scissors
- pencil
- template for goggles (follows activity)

Background
Light is necessary for vision, an important sense for many animals. Aquatic animals that depend on vision as a sense are restricted to relatively shallow water, considering the ocean depths are measured in thousands of meters. In addition to the amount of light there is also a different absorption of different colors (wavelengths) of light by water. Red and orange are absorbed most effectively while blue penetrates best. The brilliant colors associated with some kinds of marine animals, like sponges, are invisible in their natural habitat! Other marine organisms, like the colorful coral reef fish, live in shallow water where their colors show. These facts have interesting consequences for color and color patterns and their distribution among animals that live in water. Fish that live in shallow, well-lit water may have color vision. But what do most fish see? Fish that live in murky or muddy water may be almost blind and depend on touch or electrical fields to sense their surroundings.

Procedure
Students may do these two procedures at home and bring items to class.

1. Have students review their knowledge of external fish anatomy by drawing and cutting out a fish made of red construction paper. Did they remember paired pectoral and pelvic fins, the tail (caudal), dorsal and anal fins? Explain that the red color is typical of some California saltwater fish in 10m (33 ft) or more of water. Red is a common color for deep sea animals and shallow water nocturnal fish.
2. Have each student construct a pair of goggles using the pattern provided.
   a. Inexpensive blue cellophane available

in rolls from school art supply stores is folded to make *four* layers over the eye holes.

b. Tape the cellphane in place.

c. Staple, tape or tie strings to hold the goggles in place. Explain they will use the goggles for no more than five minutes. To do so may bleach (temporarily) some of their visual pigments.

During class:

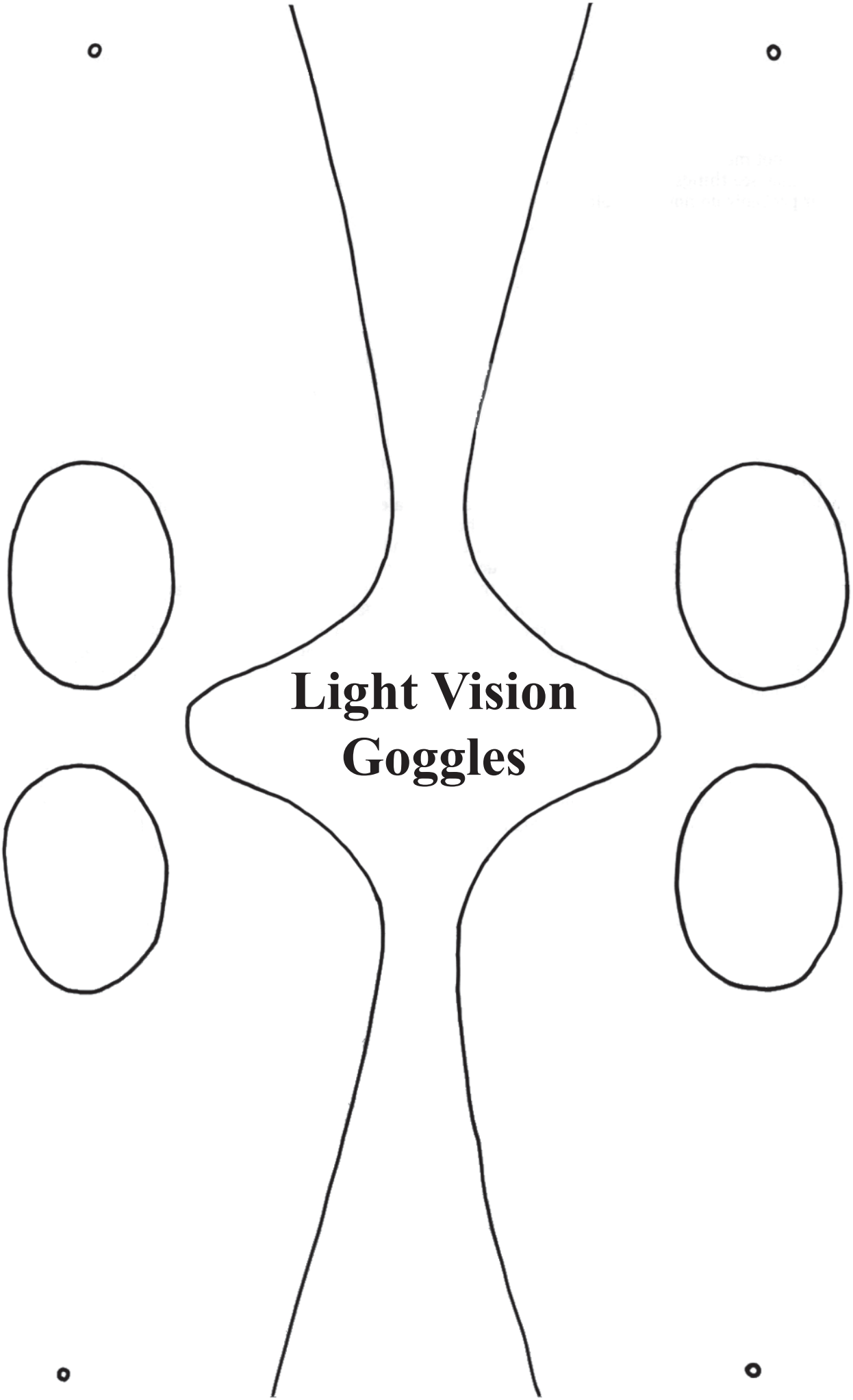
1. When the students are not in the classroom, distribute all the red fish around the room against *dark* backgrounds. Turn the classroom lights off and create dim light. It is dark in 10 meters of water. Pin or tape the fish to bulletin boards, prop on shelves, put them in corners on the floor. Hold a pair of goggles up to check that you are placing the fish against backgrounds with the same value.
2. Meet the class outside the room with the goggles. When the goggles are in place, have the students enter the room and sit down. Tell them they are predators searching for red fish in 10 meters of water. They are wearing the goggles because blue is the primary color of light that penetrates very far into water. Have them start searching for the fish at the same time. Time them if you want to repeat the exercise without the goggles.
3. Stop them before all the fish are found and have them sit back down. Remove their goggles. Now can they see the fish they missed? Why were the fish hard to see? The filter allowed only blue light through. The fish reflect only red. Under water there would be no red to see. If you wish, repeat the exercise without the goggles to compare the time it takes to find the fish when red is visible.
4. Conclude with a discussion. How is camouflage different in water? A fish that appears very colorful to us (red) may, in fact, be very well camouflaged from predators. What makes vision different in water? The fish is hard to see because red light is missing as it is being absorbed by the water and, therefore, cannot be reflected to the fish predator's eyes.
5. Have students discuss how vision might effect the predator/prey relationship. How might predators compensate for limited vision? What if the predator has the less visible coloration? How would the prey compensate?
6. Look at the color photographs. Any colorful underwater photograph was shot with a flash which provided all the wavelengths of light. Any photo in which the predominant color is blue shows what it really looks like underwater. Discuss problems in making judgments about animals based on human perceptions.

Extension

1. What about fish that live in very murky water and depend on touch and taste (or smell) to decide what to eat? Could you put together a variety of food items, some desirable and some not, which your students could find while blindfolded? Would they be willing to decide whether or not to eat something they could not see? Many animals must do so. Catfish use whiskers to feel their food and sense its chemical composition. This activity might make a great Halloween party with spaghetti for worms, etc. Just make sure that everyting is edible, if not good to eat by kids' standards.

Evaluations

- Explain why color patterns that are easy to see in the air may be hard to see underwater.
- What problems do predators face when searching for camouflaged prey?
- Develop strategies for these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Goggles